

REMARKS

This application has been reviewed in light of the Office Action dated April 29, 2008. Claims 1-8, 12 and 13 are presented for examination, of which Claims 1, 12 and 13 are in independent form. Claims 1, 4, 5, 12 and 13 have been amended to define still more clearly what Applicants regard as their invention. Favorable reconsideration is respectfully requested.

In the Office Action, Claim 1 was rejected under 35 U.S.C. § 102(b) as being anticipated by Japanese Patent 2000-150934 (Nakajima et al.). In addition, Claims 1-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,180,870 (Sano et al.) in view of U.S. Patent 5,021,100 (Ishihara et al.) further in view of *Nakajima*, and Claims 12 and 13, as being unpatentable over *Ishihara* in view of U.S. Patent 6,468,885 (Mahan et al.)¹.

As discussed in the specification, the stacking of a plurality of unit photovoltaic elements, each containing a photoactive, semiconductor layer with a distinct band gap corresponding to light of wavelengths in a specific range, is known to achieve a high conversion efficiency based on the capability of absorbing light of different wavelengths. In addition, a further improvement in conversion efficiency is obtainable by inserting an intermediate layer between two consecutively stacked unit photovoltaic elements, if the intermediate layer is capable of reflecting light of appropriate wavelengths to the unit photovoltaic element on the light-incident side and transmitting light of appropriate wavelengths to the unit photovoltaic element on the substrate side (opposite the light-incident side).

¹/ While the Office Action states that Claims 12 and 13 are rejected under 35 U.S. C. § 102(b), the reliance on two references suggests that they were meant to be rejected under 35 U.S.C. § 103(a).

Furthermore, while the overall resistivity of the intermediate layer is limited by constraints on the total thickness of that layer due to its function as the reflection/transmission layer, and other needs, the resistivity of the intermediate layer may vary in the thickness direction. Specifically, making the resistivity of the intermediate layer higher on the substrate side, which is in contact with a photovoltaic element where a defect cannot be treated by shunt passivation, may help curb the lateral spreading of a defect-induced short-circuit current in the intermediate layer and thus reduce the adverse effect of diminished electromotive force of the photovoltaic element on the substrate side.

The structure of Claim 1 offers a stacked photovoltaic device, with an intermediate light reflecting/transmitting layer inserted between two consecutively stacked unit photovoltaic elements, where the resistivity of the intermediate layer is higher on the substrate side than on the light-incident side.

Nothing in *Nakajima* is believed to disclose or teach the structure of Claim 1. The Office Action states that “a stacked photovoltaic element comprising a plurality of unit photovoltaic elements each composed of a pn- or pin-junction, connected to each other in series, wherein a zinc oxide layer is provided between two consecutively stacked unit photovoltaic elements” is disclosed in *Nakajima*’s Figure 1. Applicants respectfully disagree.

From the rejection it appears to Applicants that the Examiner may be interpreting “a unit photovoltaic element” as being *any* constituent of a photovoltaic device. Applicants note that Claim 1 clearly recites that each “unit photovoltaic element” is composed of a pn- or pin-junction, and thus contains a diode semiconductor. The claim also recites a plurality of such unit photovoltaic elements connected in series to form “a stacked photovoltaic element.” Accordingly, the feature recited in the previous paragraph requires a zinc oxide layer inserted

between two unit photovoltaic elements each composed of a pn- or pin-junction. However, what is illustrated in Figure 1 of *Nakajima* is a zinc oxide layer (diffusion preventing layer) positioned between a unit photovoltaic element (photoelectric conversion layer) and a reflective metal layer, which is not a unit photovoltaic element.

While *Nakajima* shows a structure that has only one unit photovoltaic element, nothing in that patent is believed to teach or suggest a second unit photovoltaic element stacked with the first unit photovoltaic element and positioned closer to the substrate than the first one, where a defect cannot be treated by shunt passivation. Absent such structure including at least two stacked photovoltaic elements in *Nakajima*, the structure recited in Claim 1, which includes making the resistivity of the intermediate layer higher on the substrate side in contact with such a second unit photovoltaic element, is certainly not in any way hinted at by *Nakajima*. Applicants note that Claim 1 is not anticipated by a reference merely disclosing a zinc oxide layer where the resistivity varies in the thickness direction. The structure of Claim 1 provides an intermediate light reflecting/transmitting layer inserted between two consecutively stacked unit photovoltaic elements such that the resistivity of the intermediate layer is higher on the substrate side in contact with a photovoltaic element where a defect can not be treated by shunt passivation.

Nor is anything in *Sano* in view of *Ishihara* further in view of *Nakajima* believed to disclose or teach the structure of Claim 1. Applicants agree that “a zinc oxide layer is provided between two consecutively stacked unit photovoltaic elements... wherein... a resistivity of the zinc oxide layer on the surface in contact with a unit photovoltaic element near a substrate... is higher than a resistivity of the zinc oxide layer on the surface in contact with a unit photovoltaic element further from the substrate...” is not disclosed or taught in *Sano* and *Ishihara*, separately or in combination (even assuming that such combination were proper).

Applicants submit that this feature is also not disclosed or taught in *Sano*, *Ishihara*, and *Nakajima*, separately or in combination, at least because of the lack in *Nakajima* of the recited stacked two or more photovoltaic elements.

Accordingly, for at least the reasons noted above, Claim 1 is believed to be allowable over *Sano*, *Ishihara*, and *Nakajima*, separately or in any combination.

Claim 12 is directed to a method of forming two intermediate layers to be inserted between two consecutively stacked unit photovoltaic elements. Nothing in *Ishihara* in view of *Mahan* is believed to disclose or teach the method of Claim 12.

Applicants agree that the formation of a second intermediate layer at a higher temperature than the first intermediate layer is not disclosed in *Ishihara* but submit that it is also not disclosed in *Mahan* or any combination of the two references assuming that such combination were proper. Specifically, the invention of *Mahan* as Applicants understand is directed to the formation of semiconductor material containing hydrogenated silicon or the formation of a unit photovoltaic element, rather than the formation of an intermediate light reflecting/transmitting layer containing zinc oxide or indium oxide. As the formation of an intermediate layer is not disclosed or taught in any way in *Ishihara* nor *Mahan*, it is not likely that it is disclosed or taught in any combination of the two references assuming that such combination were proper.

Accordingly, for at least the reasons noted above, Claim 12 is believed to be allowable over *Ishihara* and *Mahan*, separately or in any combination.

Claim 13 is sufficiently similar to Claim 12 that it also is believed to be allowable over *Ishihara* and *Mahan*, separately or in any combination, for the reasons discussed above.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

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